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The upgrade of the forward Muon Spectrometer of the ATLAS Experiment: the New Small Wheel project

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The current innermost stations of the ATLAS endcap muon tracking system (the Small Wheel) will be upgraded in 2019 and 2020 to retain the good precision tracking and trigger capabilities in the high background environment expected with the upcoming luminosity increase of the LHC. The upgraded detector will consist of eight layers each of Resistive Micromegas (MM) and small-strip Thin Gap Chambers (sTGC) together forming the ATLAS New Small Wheels. Large area sTGC's up to 2 m² in size and totaling an active area each of 1200 m² will be employed for fast and precise triggering. The required spatial resolution of about 100 μm will allow the Level-1 trigger track segments to be reconstructed with an angular resolution of approximately 1mrad. The precision cathode plane has strips with a 3.2mm pitch for precision readout and the cathode plane on the other side has pads to produce a 3-out-of-4 coincidence to identify passage of a track in an sTGC quadruplet, selecting which strips to read-out. The eight layers of MM detectors are arranged in multilayers of two quadruplets, for a total of about 1200 m² detection planes. All quadruplets have trapezoidal shapes with surface areas between 2 and 3 m². The readout elements consist of 300 μm wide strips with a pitch of $\sim 450 \mu\text{m}$ for a total of 2.1 M readout channels. A spatial resolution better than 100 μm independent of the track incidence angle is required.

The total number of trigger and readout channels is about 2.4 millions, and the overall power consumption is expected to be about 75 kW. The electronics design will be implemented in some 8000 front-end boards including the design of four custom front-end ASICs capable to drive trigger and tracking primitives with high speed sterilizers to drive trigger candidates to the backend trigger processor system. The construction procedures of sTGC's and MM's and of the electronic system will be reviewed along with the results obtained on full-size prototypes.

Experimental Collaboration

ATLAS

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